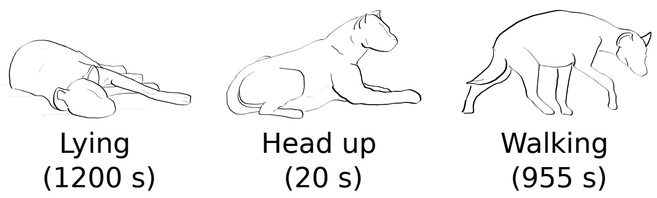
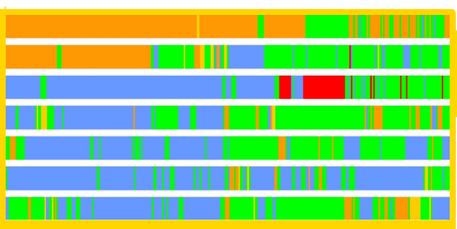
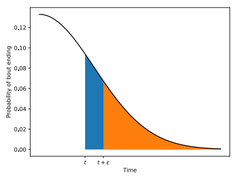
Animal behavior can be understood as behavioral sequences



Such behavioral sequences can then be analyzed to find algorithms animals use to make behavioral decisions

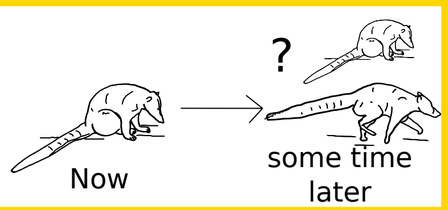
Characterizing behavioral sequences

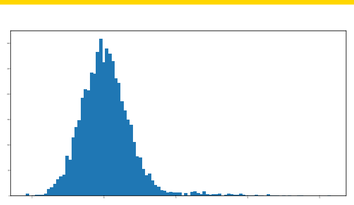




Hazard Function Instantaneous probability of a bout of behavior ending

Predictivity decay Predicting future behavior based on current behavior





Bout duration distribution Probability distrbution of the lengths of behavioral bouts

Question:

Are there general patterns in the temporal organisation of behavior in the wild?

Approach:

Continuous accelerometry of individuals from 3 species

Explanation 2: Multi-timescale behavioral processes

Behavioral decisions can be taken at a variety of different timescales, thanks to the hierarchical nature of behavior or the variability of the environment.

How animals behave:

Sequences of behavior show a common statistical structure across species

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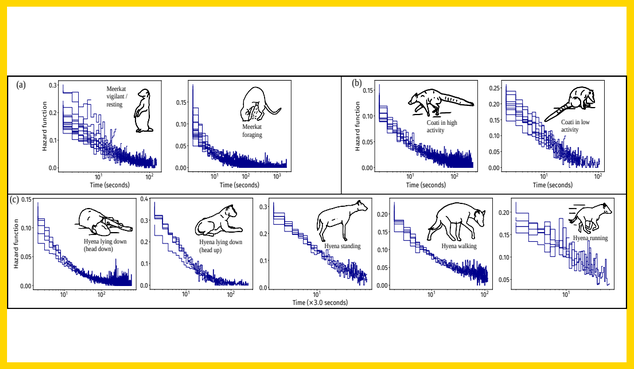
Decreasing hazard functions in all behaviors

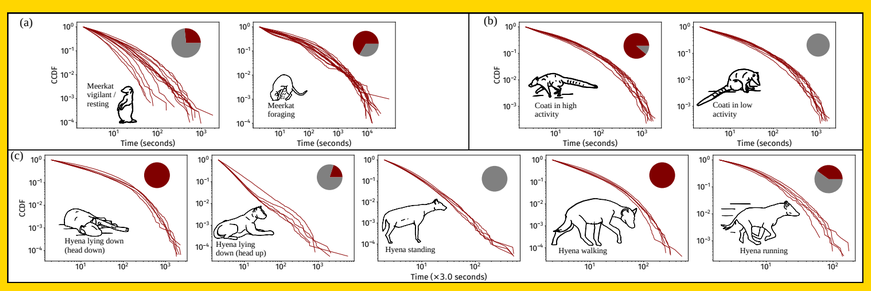


Long bouts of any behavior tend to get even longer, in all individuals, behaviors, and species

Explanation 1: Behavioral algorithms have positive feedbacks

Reinforcement (internal, social, or environmental) can lead to the appearance of patterns like these

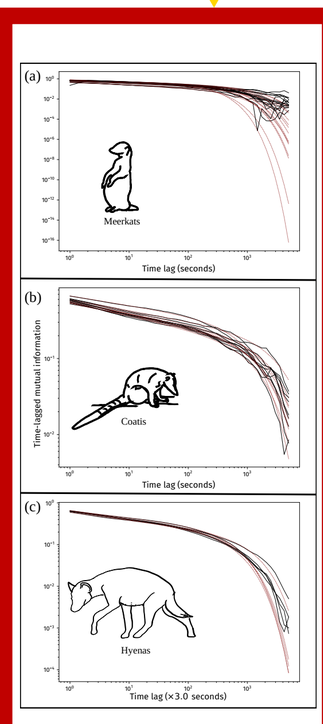
Heavy-tailed bout duration distributions in all behaviors



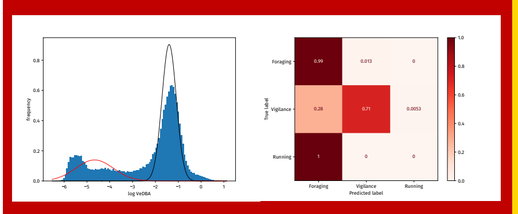
Most behavioral bouts are short, but the likelihood of very long bouts is unexpectedly high. Such distributions are often seen in self-reinforcing variables like wealth.

Scale invariant predictivity decay

Difficult to choose a characteristic time-scale for behavioral processes



Inferring behavior from accelerometers

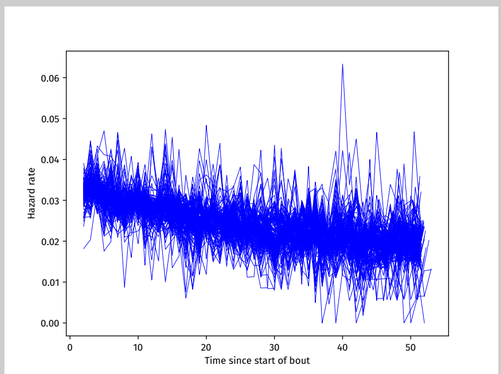


Unsupervised and supervised machine learning approaches

Effect of classification error

Classifier error likely shortens bout lengths, actually reducing the strength of effects like those described here.

Social interactions and reinforcement



Mixtures of time-scales

Specific timescales need to intersect to create the apparent scale invariance and behavioral structure seen here

bioRxiv

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DFG Deutsche Forschungsgemeinschaft

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